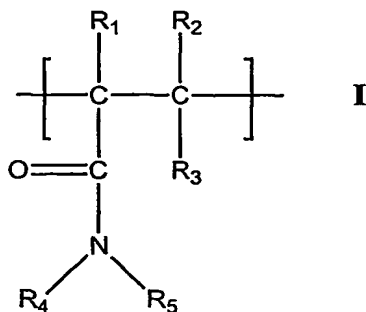


**THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:**

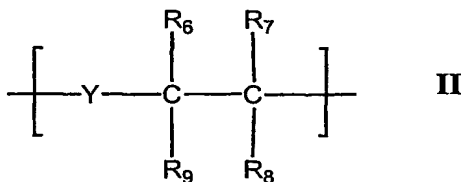
1. A synthetic co-polymer comprising one or more N-alkyl or N,N-dialkyl substituted acrylamide co-monomer, one or more hydrophilic co-monomer and one or more acryl- or methacryl- carboxylic acid co-monomer derivatised to contain a pendant cross-linkable moiety, said synthetic polymer having a number average molecular mass between about 2,000 and about 1,000,000.
2. The synthetic co-polymer according to claim 1, wherein:
  - (a) said N-alkyl or N,N-dialkyl substituted acrylamide co-monomer has a structure of Formula I:



wherein:

R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub>, R<sub>4</sub> and R<sub>5</sub> are independently selected from the group of: H and lower alkyl;

- (b) said hydrophilic co-monomer has a structure of Formula II:



wherein:

Y is O or is absent;

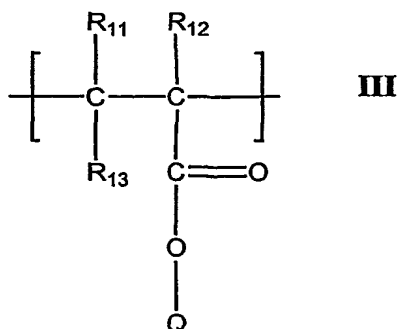
$R_6$ , and  $R_7$  are independently selected from the group of: H and lower alkyl;

$R_8$  is H, lower alkyl or  $-OR'$ , where  $R'$  is H or lower alkyl; and

$R_9$  is H, lower alkyl or  $-C(O)R_{10}$ , and

$R_{10}$  is  $-NR_4R_5$  or  $-OR''$ , where  $R''$  is H or  $CH_2CH_2OH$ ; and

- (c) said acryl- or methacryl- carboxylic acid co-monomer has a structure of Formula III:



wherein:

$R_{11}$ ,  $R_{12}$  and  $R_{13}$  are independently selected from the group of: H and lower alkyl, and

$Q$  is N-succinimido, 3-sulpho-succinimido (sodium salt), N-benzotriazolyl, N-imidazolyl and *p*-nitrophenyl.

3. The synthetic co-polymer according to claim 1 or 2, wherein said one or more N-alkyl or N,N-dialkyl substituted acrylamide co-monomer and said one or more hydrophilic co-monomer are the same.
4. The synthetic co-polymer according to claim 1 or 2, wherein said one or more N-alkyl or N,N-dialkyl substituted acrylamide co-monomer and said one or more hydrophilic co-monomer are different.
5. The synthetic co-polymer according to any one of claims 1 to 4, wherein said alkyl or lower alkyl is a straight or branched chain alkyl group having between one and eight carbon atoms. The synthetic co-polymer according to any one of

claims 1 to 4, wherein said alkyl or lower alkyl is cycloalkyl group having between three and six carbon atoms.

6. The synthetic co-polymer according to claim 2, wherein the combined molar ratio of N-alkyl or N,N-dialkyl substituted acrylamide co-monomer and hydrophilic co-monomer is between about 50% and about 99.5% and the molar ratio of derivatised acryl- or methacryl- carboxylic acid co-monomer is between about 0.5% and about 50%, wherein the sum of said molar ratios is 100%.
7. The synthetic co-polymer according to claim 3, wherein the molar ratio of N-alkyl or N,N-dialkyl substituted acrylamide co-monomer is between about 50% and about 90%, the molar ratio of the hydrophilic co-monomer is between about 5% and about 50% and the molar ratio of derivatised acryl- or methacryl- carboxylic acid co-monomer is between about 0.1% and about 15%, wherein the sum of said molar ratios is 100%.
8. The synthetic co-polymer according to any one of claims 1 to 8, wherein said one or more N-alkyl or N,N-dialkyl substituted acrylamide co-monomer is selected from the group of: N-methylacrylamide, N-ethylacrylamide, N-isopropylacrylamide (NiPAAm), N-octylacrylamide, N-cyclohexylacrylamide, N-methyl-N-ethylacrylamide, N-methylmethacrylamide, N-ethylmethacrylamide, N-isopropylmethacrylamide, N,N-dimethylacrylamide, N,N-diethylacrylamide, N,N-dimethylmethacrylamide, N,N-diethylmethacrylamide, N,N-dicyclohexylacrylamide, N-methyl-N-cyclohexylacrylamide, N-acryloylpyrrolidine, N-vinyl-2-pyrrolidinone, N-methacryloylpyrrolidine, and combinations thereof.
9. The synthetic co-polymer according to any one of claims 1 to 9, wherein said one or more hydrophilic co-monomer is a selected from the group of: acrylic acid, methacrylic acid, 2-hydroxyethyl methacrylate (HEMA), N,N-dimethylacrylamide, N,N-diethylacrylamide, 2-[N,N-

dimethylamino]ethylacrylamide, 2-[N,N-diethylamino]ethylacrylamide, N,N-diethylmethacrylamide, 2-[N,N-dimethylamino] ethylmethacrylamide, 2-[N,N-diethylamino]ethylmethacrylamide, 2-vinyl-N-pyrrolidone, 2-[N,N-diethylamino] ethylacrylate, 2-[N,N-dimethylamino]ethylacrylate, 2-[N,N-diethylamino]ethylmethacrylate, 2-[N,N-dimethylamino]ethylmethacrylate, and combinations thereof.

10. The synthetic co-polymer according to any one of claims 1 to 10, wherein said one or more acryl- or methacryl-carboxylic acid co-monomer is selected from the group of: acrylic acid, methacrylic acid, and substituted versions thereof, and said cross-linkable moiety is a succinimidyl group, an imidazole, a benzotriazole, a *p*-nitrophenol or 2-(N-morpholino)ethanesulphonic acid.
11. The synthetic co-polymer according to claim 2 that comprises N,N-dimethylacrylamide and N-acryloxysuccinimide.
12. The synthetic co-polymer according to claim 3 that comprises N-isopropylacrylamide, acrylic acid and N-acryloxysuccinimide.
13. A bio-synthetic matrix comprising:
  - (a) the synthetic co-polymer according to any one of claims 1 to 13;
  - (b) a bio-polymer; and
  - (c) an aqueous solvent,wherein said synthetic co-polymer and said bio-polymer are cross-linked through said pendant cross-linkable moiety to form a hydrogel.
14. The bio-synthetic matrix according to claim 14, wherein the amount of synthetic co-polymer is between about 0.1% and about 30% by weight, the amount of bio-polymer is between about 0.3% and about 50% by weight and the amount of aqueous solvent is between about 20% and about 99.6% by weight.

15. The bio-synthetic matrix according to claim 14 or 15, wherein said bio-polymer is selected from the group of: collagens, denatured collagens, recombinant collagens, gelatin, fibrin-fibrinogen, elastin, glycoprotein, alginate, chitosan, hyaluronic acid, chondroitin sulphate, glycosaminoglycan (proteoglycan), and derivatives thereof.
16. The bio-synthetic matrix according to any one of claims 14 to 16, further comprising one or more bioactive agent.
17. The bio-synthetic matrix according to claim 17, wherein said one or more bioactive agent is covalently bonded to said synthetic co-polymer through said pendant cross-linkable moiety.
18. The bio-synthetic matrix according to claim 18, wherein said bioactive agent comprises the pentapeptide having the sequence YIGSR.
19. The bio-synthetic matrix according to claim 17, wherein said one or more bioactive agent is dispersed in said matrix.
20. The bio-synthetic matrix according to any one of claims 14 to 20, further comprising a plurality of cells dispersed in said matrix.
21. Use of the bio-synthetic matrix according to any one of claims 14 to 21 as a scaffold for tissue regeneration in an animal in need thereof.
22. Use of the bio-synthetic matrix according to any one of claims 14 to 21 for replacement of damaged or removed tissue in an animal in need thereof.
23. The use according to claim 23, wherein said tissue is skin or part of an organ.
24. The use according to claim 23, wherein said tissue is a cornea or a part of a cornea.

25. Use of the bio-synthetic matrix according to any one of claims 14 to 21 for coating surgical implants.
26. A composition comprising:
- (a) one or more bioactive agent;
  - (b) the synthetic co-polymer according to any one of claims 1 to 13;
  - (c) a bio-polymer; and
  - (d) an aqueous solvent.
27. A composition comprising:
- (a) a plurality of cells;
  - (b) the synthetic co-polymer according to any one of claims 1 to 13;
  - (c) a bio-polymer; and
  - (d) an aqueous solvent.
28. The composition according to claim 27 or 28, wherein the amount of synthetic polymer is between about 0.1% and about 30% by weight, the amount of bio-polymer is between about 0.3% and about 50% by weight and the amount of aqueous solvent is between about 20% and about 99.6% by weight.
29. The composition according to any one of claims 27 to 29, wherein said bio-polymer is selected from the group of: collagens, denatured collagens, recombinant collagens, gelatin, fibrin-fibrinogen, elastin, glycoprotein, alginate, chitosan, hyaluronic acid, chondroitin sulphate, glycosaminoglycan (proteoglycan), and derivatives thereof.
30. The composition according to any one of claims 27 to 30, wherein said synthetic co-polymer and said bio-polymer are cross-linked.

31. The composition according to any one of claims 27 to 31, wherein said bioactive agent is covalently attached to said synthetic co-polymer through said pendant cross-linkable moiety.
32. The composition according to any one of claims 27 to 30 or 32, which is formulated as an injectable solution, wherein said synthetic co-polymer and said bio-polymer are capable of cross-linking to form a hydrogel *in vivo*.
33. The composition according to any one of claims 27 to 32, which is a pre-formed hydrogel.
34. An implant for use in tissue engineering comprising a pre-formed bio-synthetic matrix, said matrix comprising an aqueous solvent and a bio-polymer cross-linked with the synthetic co-polymer according to any one of claims 1 to 13.
35. The implant according to claim 35, wherein said bio-polymer is selected from the group of: collagens, denatured collagens, recombinant collagens, gelatin, fibrin-fibrinogen, elastin, glycoprotein, alginate, chitosan, hyaluronic acid, chondroitin sulphate, glycosaminoglycan (proteoglycan), and derivatives thereof.
36. The implant according to claim 35 or 36, wherein the amount of synthetic polymer is between about 0.1% and 30% by weight, the amount of bio-polymer is between about 0.3% and 50% by weight and the amount of aqueous solvent is between about 20% and 99.6% by weight.
37. The implant according to any one of claims 35 to 37, wherein said bio-synthetic matrix supports in-growth of nerves.
38. The implant according to any one of claims 35 to 38, further comprising one or more bioactive agent.

39. The implant according to claim 39, wherein said bioactive agent is covalently attached to said synthetic co-polymer through said pendant cross-linkable moiety.
40. The implant according to any one of claims 35 to 40, further comprising a plurality of cells dispersed in said matrix.
41. The implant according to claim 41, wherein said cells are stem cells or precursor cells.
42. Use of the implant according to any one of claims 35 to 40 as an artificial cornea.
43. A process for preparing a synthetic co-polymer comprising:
- (a) dispersing one or more N-alkyl or N,N-dialkyl substituted acrylamide co-monomer, one or more hydrophilic co-monomer and one or more acryl- or methacryl- carboxylic acid co-monomer derivatised to contain a pendant cross-linkable moiety in a solvent in the presence of an initiator;
  - (b) allowing said one or more N-alkyl or N,N-dialkyl substituted acrylamide co-monomer, one or more hydrophilic co-monomer and one or more acryl- or methacryl- carboxylic acid co-monomer to polymerise to form a synthetic co-polymer, and
  - (c) optionally purifying said synthetic co-polymer.
44. A process for preparing a bio-synthetic matrix comprising the steps of:
- (a) preparing a synthetic co-polymer by the process according to claim 44;
  - (b) dispersing said synthetic co-polymer and a bio-polymer in an aqueous medium; and
  - (c) allowing said synthetic co-polymer and said bio-polymer to cross-link to provide said bio-synthetic matrix.



45. The process according to claim 44 or 45, wherein the N-alkyl or N,N-dialkyl substituted acrylamide co-monomer and the hydrophilic co-monomer are the same.
46. The process according to claim 44 or 45, wherein the N-alkyl or N,N-dialkyl substituted acrylamide co-monomer and the hydrophilic co-monomer are different.
47. The process according to claim 45, further comprising mixing said synthetic co-polymer with one or more bioactive agent prior to step (b) and allowing said bioactive agent to cross-link to said synthetic co-polymer through said pendant cross-linkable moiety.
48. The process according to claim 45, further comprising mixing said synthetic co-polymer and said bio-polymer with a plurality of cells in step (b).
49. A synthetic co-polymer produced by the process according to claim 44.
50. A bio-synthetic matrix produced by the process according to claim 45.